

Ice Flows

Task Overview

This activity involves observing substances that flow under a variety of conditions, connecting to the flow of glaciers. Set up a series of three kinds of exploratory zones that allow students to categorize, compare, and contrast the flowing and elastic properties of different materials, and an area dedicated to glaciers.

- **Viscosity Zone:** Select several examples of materials of varying viscosity at different temperatures (warmed, room temperature, refrigerated, or frozen) and set up one or more exploratory zones for students to experience how different substances flow.
- **Elasticity Zone:** Select several examples of materials of varying elasticity and set up one or more exploratory zones for students to experience how different items rebound to their original shape after experiencing stress.
- **Glacier Zone:** Use the PVC pipe, and 'Flubber' to model how glaciers flow.

Standards

National Science Education Standards addressed:

- ✓ Science as Inquiry-Content Standard A
- ✓ Energy in the Earth System-Content Standard D
- ✓ History and Nature of Science-Content Standard G

Benchmarks for Science Literacy addressed:

- ✓ The Nature of Science
 - 1B-Scientific Inquiry
 - 1C-The Scientific Enterprise
- ✓ The Physical Setting
 - 4B-The Earth
 - 4C-Processes that Shape the Earth
 - 4F-Motion
- ✓ Common Themes
 - 11A-Systems

Objectives

Students will identify different types of flow patterns under several conditions

Students will examine the properties of flowing ice in a glacier from using homemade 'Flubber'

Materials

Ice Flows Demonstration

Viscosity and Elasticity Zone

- | | |
|-----------------------------|-------------------|
| • PLAY-DOH or modeling clay | • pancake batter |
| • honey | • cake frosting |
| • oobleck | • chocolate syrup |
| • molasses | • ice cream |
| • peanut butter | • canola oil |

- ketchup
- toothpaste
- a variety of candy bars (at different temperatures)
- rubber bands, elastic tape
- plush toys
- sponge
- chocolate bars (warm and frozen)

Requires a flat surface at a slight incline that empties into a pan, plate, or bowl.

Glacial Zone

- 2 foot-long section of 4" PVC pipe, cut in half lengthwise
- 3-4 recipes 'Flubber' (of different colors)

A direct experience of ice flowing is difficult to create in a classroom setting. This demonstration provides a basis for discussing the *viscoelastic* properties of other familiar materials and then applying it to ice, especially as students explore how glaciers move and how glaciers leave their mark.

Procedure

Demonstrating Glacier Flow

Materials: One recipe of 'Flubber'

Mix #1

3/4 cup of warm water

1 cup of white glue

food coloring (optional)

Mix #2

2 tsp of Borax

1/2 cup of warm water

Procedure:

Simply combine the two mixtures and work through the hands for several minutes until a consistent texture results. Drain any excess water. 'Flubber' is easy to make and fun to work with and does not stick to hair or skin once formed (glue may stick to hands while working the 'Flubber' to its correct consistency), however the Borax and glue are toxic and should not be ingested. We therefore advise against allowing young children to play with 'Flubber' unsupervised. 'Flubber' can be stored for several weeks in an air-tight bag (e.g. zip-lock). Simply rework some warm water into the Flubber to return it to a desired consistency.

Experiment: 'Flubber' behaves just like ice. At low stresses it deforms plastically. But at high stresses (like when you pull it apart) it undergoes brittle failure. Ice deforms plastically most of the time – that's what allows it to flow. When brittle failure occurs, crevasses open up.

Material:

- 2 (or longer) foot-long section of 4" PVC pipe, cut in half lengthwise, to simulate a valley
- 3-4 recipes Flubber (of at least 2 different colors)

To examine the properties of ice in a glacier form, flatten out the 'Flubber' from a round lump into

a flat pancake. In one section of the PVC pipe, lay the flattened out 'Flubber' block into the top of the 'valley' using alternating colors, such as green and white. The alternating colors visually accentuate velocity gradients during flow. You can incline the pipe and see how fast the 'Flubber' flows. Note that the flow is slower near the sides of the pipe because of friction from the valley walls. To expand on the initial experiment, a comparison of flow can be done with a variety of materials on the pipe. An example is you can wet the pipe (the 'Flubber' should flow faster because of less friction). Or you can make a continent out of clay or papier maché including mountains, cover it with plastic wrap or foil and then try the 'Flubber'. Another variation is comparing the viscosity of the 'Flubber' at different temperatures. You can put one lump in the freezer for a while and compare how fast it flows compared to a warmer piece of 'Flubber' (warm ice deforms more easily than cold ice).

Assessment

- 1.) How does the 'Flubber' simulate how ice flows?
- 2.) What difference did you notice in the flow rate of the cold 'Flubber' versus the warm 'Flubber'?
- 3.) How could your observation of the flowing 'Flubber' be translated into ice flowing as a glacier?

Information provided by:

US ITASE -International Trans-Antarctic Scientific Expedition

Teachers Resource

<http://www2.umaine.edu/USITASE/teachers/index.html>

and

Educating K-12 Students about Glacier Dynamics in a Changing Climate

Leigh Stearns and Gordon Hamilton

University of Maine, Climate Change Institute

